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## Preparation of Internationalized Strings ("stringprep")

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### Abstract

This document describes a framework for preparing text strings in order to increase the likelihood that string input and string comparison work in ways that make sense for typical users throughout the world. The stringprep protocol is useful for protocol identifier values, company and personal names, internationalized domain names, and other text strings.

This document does not specify how protocols should prepare text strings. Protocols must create profiles of stringprep in order to fully specify the processing options.

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## [1. Introduction](#)

Application programs can display text in many different ways. Similarly, a user can enter text into an application program in a myriad of fashions. Internationalized text (that is, text that is not restricted to the narrow set of US-ASCII characters) has many input and display behaviors that make it difficult to compare text in a consistent fashion.

This document specifies a framework of text processing rules. Other protocols can create profiles of these rules; these profiles will allow users to enter internationalized text strings in applications and have the highest chance of getting the content of the strings correct. In this case, "correct" means that if two different people enter what they think is the same string into two different input mechanisms, the strings should match on a character-by-character basis.

In addition to helping string matching, profiles of stringprep can also exclude characters that should not normally appear in text that is used in the protocol. The profile can prevent such characters by changing the characters to be excluded to other characters, by removing those characters, or by causing an error if the characters would appear in the output. For example, because the backspace character can cause unpredictable display results, a profile can specify that a string that would have a backspace character in it would cause an error.

A profile of stringprep converts a single string of input characters to a string of output characters, or returns an error if the output string would contain a prohibited character. Stringprep profiles cannot both emit a string and return an error.

Stringprep profiles cannot account for all of the variations that might occur or that a user might expect. In particular, a profile will not be able to account for choice of spellings in all languages for all scripts because the number of alternative spellings of words and phrases is immense. Users would probably expect all spelling equivalents to be made equivalent, or none of them to be. Examples of spelling equivalents include "theater" vs. "theatre", and "hemoglobin" vs. "h<U+00E6>moglobin" in American vs. British English. Other examples are simplified Chinese spellings of names (for example, "<U+7EDF><U+4E00><U+7801>") vs. the equivalent traditional Chinese spelling (for example, "<U+7D71><U+4E00><U+78BC>"). Language-specific equivalences such as "Aepfel" vs. "<U+00C4>pfel", which are sometimes considered equivalent in German, may not be considered equivalent in other languages.

## [1.1 Terminology](#)

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#).

Note: A glossary of terms used in Unicode and ISO/IEC 10646 can be found in [\[Glossary\]](#). Information on the 10646/Unicode character encoding model can be found in [\[CharModel\]](#).

Character names in this document use the notation for code points and names from the Unicode Standard [\[Unicode3.1\]](#) and ISO/IEC 10646 [\[ISO10646\]](#). For example, the letter "a" may be represented as either "U+0061" or "LATIN SMALL LETTER A". In the lists of mappings and the prohibited characters, the "U+" is left off to make the lists easier to read. The comments for character ranges are shown in square brackets (such as "[CONTROL CHARACTERS]") and do not come from the standards.

## [1.2 Using stringprep in protocols](#)

The stringprep protocol does not stand on its own; it has to be used by

other protocols at precisely-defined places in those other protocols. For example, a protocol that has names that come from the entire ISO/IEC [10646](#) [ISO10646] character repertoire might specify that only names that have been processed with a particular profile of stringprep are legal. Another example would be a protocol that does string comparison as a step in the protocol; that protocol might specify that such comparison is done only after processing the strings with a specific profile of stringprep.

When developers wish to allow users as wide of a range of characters as possible in input text strings, they should, where possible, cause stringprep to convert characters from the input string to a canonical form instead of prohibiting them.

Although it would be easy to use the stringprep process to "correct" perceived mis-features or bugs in the current character standards, stringprep profiles SHOULD NOT do so.

A profile of stringprep can create tables different from those in the appendixes of this document, but it will be an exception when they do. The intention of stringprep is to define the tables and have the profiles of stringprep select among those defined tables.

A profile of stringprep MUST include all of the following:

- The intended applicability of the profile
- The character repertoire that is the input and output to stringprep
- The mapping tables from this document used (as described in [Section 3](#))
- Any additional mapping tables specific to the profile
- The Unicode normalization used, if any (as described in [Section 4](#))
- The tables from this document of characters that are prohibited as output (as described in [Section 5](#))
- Any additional characters that are prohibited as output specific to the profile

Each profile MUST state the character repertoire on which the profile will operate. [Appendix A](#) lists the Unicode repertoires that can be selected. No repertoire is ever complete, and it is expected that characters will be added to the Unicode repertoire for the foreseeable future. [Section 6](#) of this document describes how to handle characters that are assigned in later versions of the Unicode repertoires. Subsections of [Appendix A](#) also list unassigned code points for each repertoire.

This profile lists the unassigned code points in the range 0 to 10FFFF

for Unicode 3.1 in [Appendix A](#). The list in [Appendix A](#) MUST be used by implementations of this specification. If there are any discrepancies between the list in [Appendix A](#) and the Unicode 3.1 specification, the list in [Appendix A](#) always takes precedence.

Each profile of stringprep MUST be registered with IANA. The registration procedure is described in the IANA Considerations appendix; basically, the IESG must review each profile of stringprep. Protocol developers are strongly encouraged to look through the IANA profile registry when creating new profiles for stringprep, and to re-use logic from earlier profiles where possible in new profiles. In some cases, an existing profile can be reused by a different protocol.

## [2. Preparation Overview](#)

The steps for preparing strings are:

- 1) Map -- For each character in the input, check if it has a mapping and, if so, replace it with its mapping. This is described in [Section 3](#).
- 2) Normalize -- Possibly normalize the result of step 1 using Unicode normalization. This is described in [Section 4](#).
- 3) Look for prohibited output -- Check for any characters that are not allowed in the output. If any are found, return an error. This is described in [Section 5](#).

The above steps MUST be performed in the order given to comply with this specification.

The mappings described in [Section 3](#), and the optional Unicode normalization described in [Section 4](#), can be one-to-none, one-to-one, or one-to-many. That is, some characters might be eliminated or replaced by more than one character, and the output of this step might be shorter or longer than the input. Because of this, the system using stringprep MUST be prepared to receive a longer or shorter string than the one input in the stringprep algorithm.

## [3. Mapping](#)

Each character in the input stream MUST be checked against a mapping table. The mapping table SHOULD come from this document, although the mapping table MAY be added to or altered by the profile. The mapping tables are subsections of [Appendix B](#).

The lists in [Appendix B](#) MUST be used by implementations of this specification. If there are any discrepancies between the lists in [Appendix B](#) and subsections below, the lists in [Appendix B](#) always takes precedence.

For any individual character, the mapping table MAY specify that a character be mapped to nothing, or mapped to one other character, or mapped to a string of other characters.

Mapped characters are not re-scanned during the mapping step. That is, if character A at position X is mapped to character B, character B which is now at position X is not checked against the mapping table.

### [3.1](#) Commonly mapped to nothing

The following characters are simply deleted from the input (that is, they are mapped to nothing) because their presence or absence in protocol identifiers should not make two strings different. They are listed in Table B.1.

Some characters are only useful in line-based text, and are otherwise invisible and ignored.

00AD; SOFT HYPHEN  
1806; MONGOLIAN TODO SOFT HYPHEN  
200B; ZERO WIDTH SPACE  
FEFF; ZERO WIDTH NO-BREAK SPACE

Variation selectors and cursive connectors select different glyphs, but do not bear semantics.

180B; MONGOLIAN FREE VARIATION SELECTOR ONE  
180C; MONGOLIAN FREE VARIATION SELECTOR TWO  
180D; MONGOLIAN FREE VARIATION SELECTOR THREE  
200C; ZERO WIDTH NON-JOINER  
200D; ZERO WIDTH JOINER

### [3.2](#) Case folding

If a profile is going to map characters for case-insensitive comparison, that profile SHOULD map using either [Appendix B.2](#) or [Appendix B.3](#).

[Appendix B.2](#) is for profiles that also use Unicode normalization form KC, while [Appendix B.3](#) is for profiles that do not use Unicode normalization. These tables map from uppercase to lowercase character. Note that this could have been "change all lowercase characters into uppercase characters". However, the upper-to-lower folding was chosen because there is a tradition of using lowercase in current Internet applications and protocols.

If a profile creates its own mapping tables for case folding, they SHOULD be based on [\[UTR21\]](#), and SHOULD map from uppercase characters to lowercase. The "CaseFolding.txt" file from the Unicode database SHOULD be used to prepare the mapping table. The profile SHOULD do full case mapping (that is, using statuses C, F, and I).

If the profile is using Unicode normalization form KC (as described in [Section 4](#) of this document), it is important to note that there are some characters that do not have mappings in [\[UTR21\]](#) but still need processing. These characters include a few Greek characters and many symbols that contain Latin characters. The list of characters to add to the mapping table can be determined by the following algorithm:

```
b = NormalizeWithKC(Fold(a));  
c = NormalizeWithKC(Fold(b));  
if c is not the same as b, add a mapping for "a to c".
```

Because `NormalizeWithKC(Fold(c))` always equals `c`, the table is stable from that point on.

[Appendix B.3](#) is derived from the `CaseFolding-3.txt` file associated with Unicode 3.1; [Appendix B.2](#) is based on [Appendix B.3](#) with the additional characters added from the algorithm above.

Authors of profiles of this document need to consider the effects of changing the mapping of any currently-assigned character when updating their profiles. Adding a new mapping for a currently-assigned character, or changing an existing mapping, could change the behavior that users see in both systems that have been updated and systems that have not been updated.

#### [4. Normalization](#)

The output of the mapping step is optionally normalized using one of the Unicode normalization forms, as described in [\[UAX15\]](#). A profile can specify one of two options for Unicode normalization:

- no normalization
- Unicode normalization with form KC

A profile MAY choose to do no normalization. However, such a profile can easily yield results that will be surprising to typical users, depending on the input mechanism they use. For example, some input mechanisms enter compatibility characters that look exactly like the underlying characters, but have different code points. Another example of where Unicode normalization helps create predictable results is with characters that have multiple combining diacritics: normalization orders those diacritics in a predictable fashion.

On the other hand, Unicode normalization requires fairly large tables and somewhat complicated character reordering logic. The size and complexity should not be considered daunting except in the most restricted of environments, and needs to be weighed against the problems of user surprise from comparing unnormalized strings.

Note that the tables used for normalization are not given in this document, but instead must be derived from the Unicode database, as

described in [\[UAX15\]](#).

There is a third form of normalization, Unicode normalization with form [C](#). If a profile is going to use a Unicode normalization, it MUST use Unicode normalization form KC. Form KC maps many "compatibility characters" to their equivalents. Some user interface systems make it possible to enter compatibility characters instead of the base equivalents. Thus, using form KC instead of form C will cause more strings that users would expect to match to actually match.

A profile that specifies Unicode normalization MUST use the normalization in [\[UAX15\]](#) that is associated with the version of the Unicode character set specified for the protocol.

The composition process described in [\[UAX15\]](#) requires a fixed composition version of Unicode to ensure that strings normalized under one version of Unicode remain normalized under all future versions of Unicode.

The IETF is relying on Unicode not to change the normalization of currently-assigned characters in future versions of normalization. If a future version of the normalization tables changes the normalized value of an existing character, authors of profiles of this document have to look at the changes very carefully before they update their normalization tables. Such a change could change the behavior that users see in both systems that have been updated and systems that have not been updated.

## [5](#). Prohibited Output

Before the text can be emitted, it MUST be checked for prohibited code points. There is a variety of prohibited code points, as described in this section. A profile of this document MAY use all or some of the tables in [Appendix C](#).

The stringprep process never emits both an error and a string. If an error is detected during the checking for prohibited code points, only an error is returned.

Note that the subsections below describe how the tables in [Appendix C](#) were formed. They are here for people who want to understand more, but they should be ignored by implementors. Implementations that use tables MUST map based on the tables themselves, not based on the descriptions in this section of how the tables were created.

The lists in [Appendix C](#) MUST be used by implementations of this specification. If there are any discrepancies between the lists in [Appendix C](#) and subsections below, the lists in [Appendix C](#) always takes precedence.

Some code points listed in one section would also appear in other



sections.

It is important to note that a profile of this document MAY prohibit additional characters. For example, a protocol might treat an ASCII character as special and therefore not allow it in names. Specifically, the tables in [Appendix C](#) do not contain any ASCII characters, so it is very likely that profiles will either add those characters to the tables as they are used in the profile, or that the protocols themselves will prohibit the characters.

Each subsection of this section has a matching subsection in Appendix [C](#). For example, the characters listed in [section 5.1](#) are listed in Appendix C.1.

### [5.1](#) Space characters

Space characters can make accurate visual transcription of names nearly impossible and could lead to user entry errors in many ways. Note that the ASCII space character (U+0020) is not included in the list below.

00A0; NO-BREAK SPACE  
1680; OGHAM SPACE MARK  
2000; EN QUAD  
2001; EM QUAD  
2002; EN SPACE  
2003; EM SPACE  
2004; THREE-PER-EM SPACE  
2005; FOUR-PER-EM SPACE  
2006; SIX-PER-EM SPACE  
2007; FIGURE SPACE  
2008; PUNCTUATION SPACE  
2009; THIN SPACE  
200A; HAIR SPACE  
202F; NARROW NO-BREAK SPACE  
3000; IDEOGRAPHIC SPACE

### [5.2](#) Control characters

Control characters (or characters with control function) cannot be seen and can cause unpredictable results when displayed. Note that additional control characters (U+0000 through U+001F, and U+007F) are not listed below.

0080-009F; [CONTROL CHARACTERS]  
070F; SYRIAC ABBREVIATION MARK  
180E; MONGOLIAN VOWEL SEPARATOR  
2028; LINE SEPARATOR  
2029; PARAGRAPH SEPARATOR  
206A-206F; [CONTROL CHARACTERS]  
FFF9-FFFC; [CONTROL CHARACTERS]  
1D173-1D17A; [MUSICAL CONTROL CHARACTERS]

### [5.3](#) Private use and replacement characters

Because private-use characters do not have defined meanings, they are likely to be prohibited. The private-use characters are:

E000–F8FF; [PRIVATE USE, PLANE 0]  
F0000–FFFFD; [PRIVATE USE, PLANE 15]  
100000–10FFFFD; [PRIVATE USE, PLANE 16]

Although the replacement character (U+FFFD) might be used when a name is displayed, it doesn't make sense for it to be part of the name itself. It is often displayed by renderers to indicate "there would be some character here, but it cannot be rendered". For example, on a computer with no Asian fonts, a name with three ideographs might be rendered with three replacement characters.

FFFD; REPLACEMENT CHARACTER

### [5.4](#) Non-character code points

Non-character code points are code points that have been allocated in ISO/IEC 10646 but are not characters. Because they are already assigned, they are guaranteed not to later change into characters.

FDD0–FDEF; [NONCHARACTER CODE POINTS]  
FFFE–FFFF; [NONCHARACTER CODE POINTS]  
1FFFE–1FFFF; [NONCHARACTER CODE POINTS]  
2FFFE–2FFFF; [NONCHARACTER CODE POINTS]  
3FFFE–3FFFF; [NONCHARACTER CODE POINTS]  
4FFFE–4FFFF; [NONCHARACTER CODE POINTS]  
5FFFE–5FFFF; [NONCHARACTER CODE POINTS]  
6FFFE–6FFFF; [NONCHARACTER CODE POINTS]  
7FFFE–7FFFF; [NONCHARACTER CODE POINTS]  
8FFFE–8FFFF; [NONCHARACTER CODE POINTS]  
9FFFE–9FFFF; [NONCHARACTER CODE POINTS]  
AFFFE–AFFFF; [NONCHARACTER CODE POINTS]  
BFFFE–BFFFF; [NONCHARACTER CODE POINTS]  
CFFFE–CFFFF; [NONCHARACTER CODE POINTS]  
DFFFE–DFFFF; [NONCHARACTER CODE POINTS]  
EFFFE–EFFFF; [NONCHARACTER CODE POINTS]  
FFFFE–FFFFF; [NONCHARACTER CODE POINTS]  
10FFFE–10FFFF; [NONCHARACTER CODE POINTS]

The non-character code points are listed in the PropList.txt file from the Unicode database.

### [5.5](#) Surrogate codes

The following code points are permanently reserved for use as surrogate

code values in the UTF-16 encoding, will never be assigned to characters in the Unicode repertoire, and are therefore prohibited:

D800–DFFF; [SURROGATE CODES]

## [5.6](#) Inappropriate for plain text

The following characters do not appear in regular text.

FFF9; INTERLINEAR ANNOTATION ANCHOR  
FFFA; INTERLINEAR ANNOTATION SEPARATOR  
FFFB; INTERLINEAR ANNOTATION TERMINATOR  
FFFC; OBJECT REPLACEMENT CHARACTER

## [5.7](#) Inappropriate for canonical representation

The ideographic description characters allow different sequences of characters to be rendered the same way, which makes them inappropriate for names that have to have a single canonical representation.

2FF0–2FFB; [IDEOGRAPHIC DESCRIPTION CHARACTERS]

## [5.8](#) Change display properties

The following characters, some of which are deprecated in Unicode, can cause changes in display or the order in which characters appear when rendered.

200E; LEFT-TO-RIGHT MARK  
200F; RIGHT-TO-LEFT MARK  
202A; LEFT-TO-RIGHT EMBEDDING  
202B; RIGHT-TO-LEFT EMBEDDING  
202C; POP DIRECTIONAL FORMATTING  
202D; LEFT-TO-RIGHT OVERRIDE  
202E; RIGHT-TO-LEFT OVERRIDE  
206A; INHIBIT SYMMETRIC SWAPPING  
206B; ACTIVATE SYMMETRIC SWAPPING  
206C; INHIBIT ARABIC FORM SHAPING  
206D; ACTIVATE ARABIC FORM SHAPING  
206E; NATIONAL DIGIT SHAPES  
206F; NOMINAL DIGIT SHAPES

## [5.9](#) Tagging characters

The following characters are used for tagging text and are invisible.

E0001; LANGUAGE TAG  
E0020–E007F; [TAGGING CHARACTERS]

## [6](#). Unassigned Code Points in Stringprep Profiles

This section describes two different types of strings in typical protocols where internationalized strings are used: "stored strings" and "queries". Of course, different Internet protocols use strings very differently, so these terms cannot be used exactly in every protocol that needs to use stringprep. In general, "stored strings" are strings that are used in protocol identifiers and named entities, such as names in digital certificates and DNS domain name parts. "Queries" are strings that are used to match against strings that are stored identifiers, such as user-entered names for digital certificate authorities and DNS lookups.

All code points not assigned in the character repertoire named in a stringprep profile are called "unassigned code points". Stored strings using the profile **MUST NOT** contain any unassigned code points. Queries for matching strings **MAY** contain unassigned code points. Note that this is the only part of this document where the requirements for queries differs from the requirements for stored strings.

Using two different policies for where unassigned code points can appear removes the need for versioning in protocols that use stringprep profiles. This is very useful since it makes the overall processing simpler and does not impose a "protocol" to handle versioning. It is expected that the ISO/IEC 10646 and Unicode repertoires will be updated fairly frequently; at the time that this document is being written, it has happened approximately once a year. Each time a new version of a repertoire appears, a new version of a profile **MAY** be created. Some end users will want to use the new code points as soon as they are defined.

The list of unassigned code points **MUST** be given in a profile, and that list **MUST** be used by implementations of the profile.

The goal of the requirements in this section is to prevent comparisons between two strings that were both permitted to contain unassigned code points. When two strings X and Y are compared and string X was prepared in a way that permits unassigned code points, a negative result to the comparison is not definitive; it's possible that the strings don't match even though they would match if a more recent version of the profile were used for Y. However, if both X and Y were prepared in a way that permits unassigned code points, something worse can happen: even a positive result for the comparison is not definitive. It is possible that the strings do match even though they would not match if a more recent version of the profile were used (one that prohibits a code point appearing in both X and Y).

Due to the way that versioning is handled in this section, stored strings that are embedded in structures that cannot be changed (such as the signed parts of digital certificates) **MUST NOT** contain any unassigned code points.

## [6.1](#) Categories of code points

Each code point in a repertoire named by a profile of stringprep can be categorized by how it acts in the process described in earlier sections of this document:

- A0      Code points that can be in the output
- MN      Code points that cannot be in the output because they never appear as output from mapping or normalization
- D        Code points that cannot be in the output because they are disallowed in the prohibition step
- U        Unassigned code points

A subsequent version of a profile that references a newer version of a repertoire with new code points will inherently have some code points move from category U to either D, MN, or A0. For backwards compatibility, a subsequent version of a profile **MUST NOT** move code points from any other category. That is, current A0, MN, or D code points **MUST NOT** ever change to a different category.

Stored strings **MUST NOT** contain any code points outside of A0 for the latest version of a profile. That is, they are forbidden to contain code points from the MN, D, or U categories.

Applications creating queries **MUST** treat U code points as if they were A0 when preparing the query to be entered in the process described by a profile of stringprep. Those applications **MAY** optionally have a preprocessor that provide stricter checks: treating unassigned code points in the input as errors, or warning the user about the fact that the code point is unassigned in the version of a profile that the software is based on; such a choice is a local matter for the software.

## [6.2](#) Reasons for difference between stored strings and queries

Different software using different versions of a stringprep profile need to interoperate with maximal compatibility. The scheme described in this section (stored strings **MUST NOT** contain unassigned code points, queries **MAY** include unassigned code points) allows that compatibility without introducing any known security or interoperability issues.

The list below shows what happens if a query contains a code point from category U that is allowed in a newer version of a profile. The query either matches the string that was intended, or matches no string at all. In this list, the query comes from an application using version "oldVersion" of a profile, the stored string was created using version "newVersion" of the same profile, and the code point X was in category U in oldVersion, and has changed category to A0, MN, or D. There are 3 possible scenarios:

1. X is assigned to A0 -- In newVersion, X is in category A0. Because the application passed X through, it gets back a positive match with the stored string. There is one exceptional case, where X is a combining mark.

The order of combining marks is normalized, so if another combining mark Y has a lower combining class than X then XY will be put in the canonical order YX. (Unassigned code points are never reordered, so this doesn't happen in oldVersion). If the query contains YX, the query will get positive match with the stored string. However, no string can be stored with XY, so a query with XY will get a negative answer to the test for matching.

2. X is assigned to MN -- In newVersion, X is normalized to code point "nX" and therefore X is now put in category MN. This cannot exist in any stored string, so any query containing X will get a negative answer to the test for matching. Note, however, if the query had contained the letter nX, it would have positively matched.

3. X is assigned to D -- In newVersion, X is in category D. This cannot exist in any stored string, so any query containing X will get a negative answer to the test for matching.

In none of the cases does the query get data for a stored string other than the one it actually tried to match against.

The processing in this document is always stable. If a string S is the result of processing on newVersion, then it will remain the same when processed on oldVersion.

### 6.3 Versions of applications and stored strings

Another way to see that this versioning system works is to compare what happens when an application uses a newer or older version of this document.

Newer query application -- Suppose that a querying application is using version newVersion and the stored string was created using version oldVersion. This case is simple: there will be no characters in the stored string that cannot be queried by the application because the new profile uses a superset of the code points used for making the stored string.

Newer stored string -- Suppose that an querying application is using oldVersion and the stored string was created using a profile that uses newVersion. Because the querying application passed through any unassigned code points, the user can query on stored strings that use code points in newVersion. No stored strings can have code points that are unassigned in newVersion, since that is illegal. In this case, the querying application has to enter the unassigned code points in the proper order, and has to use unassigned code points that would make it

through both the mapping and the normalization steps.

## 7. References

### 7.1 Normative references

[UAX15] Mark Davis and Martin Duerst. Unicode Standard Annex #15: Unicode Normalization Forms, Version 3.1.0.  
<<http://www.unicode.org/unicode/reports/tr15/tr15-21.html>>.

### 7.2 Informative references

[CharModel] Unicode Technical Report;17, Character Encoding Model.  
<<http://www.unicode.org/unicode/reports/tr17/>>.

[Glossary] Unicode Glossary, <<http://www.unicode.org/glossary/>>.

[RFC2119] Scott Bradner, "Key words for use in RFCs to Indicate Requirement Levels", March 1997, [RFC 2119](#).

[RFC2434] Thomas Narten and Harald Alvestrand, "Guidelines for IANA Considerations", October 1998, [RFC 2434](#).

[Unicode3.1] The Unicode Standard, Version 3.1.0: The Unicode Consortium. The Unicode Standard, Version 3.0. Reading, MA, Addison-Wesley Developers Press, 2000. ISBN 0-201-61633-5, as amended by: Unicode Standard Annex #27: Unicode 3.1  
<<http://www.unicode.org/unicode/reports/tr27/tr27-4.html>>.

[UTR21] Mark Davis. Case Mappings. Unicode Technical Report 21.  
<<http://www.unicode.org/unicode/reports/tr21/>>.

## 8. Security Considerations

The Unicode and ISO/IEC 10646 repertoires have many characters that look similar. In many cases, users of security protocols might do visual matching, such as when comparing the names of trusted third parties. Because it is impossible to map similar-looking characters without a great deal of context such as knowing the fonts used, stringprep does nothing to map similar-looking characters together nor to prohibit some characters because they look like others.

## 9. IANA Considerations

Stringprep profiles MUST have IETF consensus as described in [[RFC 2434](#)]. Each profile MUST be reviewed by the IESG before it is registered. The IESG MAY change a profile before registration.

IANA will start a registry of stringprep profiles. The registry will be a single text file that lists the known profiles. Each entry in the registry will have three fields:

- Profile name
- RFC in which the profile is defined
- Indicator whether or not this is the most current version of the profile

Each version of a profile will remain listed in the registry forever. That is, if a new version of a profile supersedes an earlier version, both versions will continue to be listed in the registry, but the current version indicator will be turned off for the earlier version and turned on for the newer version.

## 10. Acknowledgements

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The IDN namprep design team made many useful changes to the first draft. That team and its advisors include:

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## [A](#). Unicode repertoires

The following is the only repertoire covered in this document:

Unicode 3.1, as defined in [[Unicode3.1](#)].

### [A.1](#) Unassigned code points in Unicode 3.1

----- Start Table A.1 -----

0220-0221  
0234-024F  
02AE-02AF  
02EF-02FF  
034F-035F  
0363-0373  
0376-0379  
037B-037D  
037F-0383  
038B  
038D  
03A2  
03CF  
03D8-03D9  
03F6-03FF  
0487  
048A-048B  
04C5-04C6  
04C9-04CA  
04CD-04CF  
04F6-04F7  
04FA-0530  
0557-0558  
0560  
0588  
058B-0590  
05A2  
05BA  
05C5-05CF  
05EB-05EF  
05F5-060B

060D-061A  
061C-061E  
0620  
063B-063F  
0656-065F  
066E-066F  
06EE-06EF  
06FF  
070E  
072D-072F  
074B-077F  
07B1-0900  
0904  
093A-093B  
094E-094F  
0955-0957  
0971-0980  
0984  
098D-098E  
0991-0992  
09A9  
09B1  
09B3-09B5  
09BA-09BB  
09BD  
09C5-09C6  
09C9-09CA  
09CE-09D6  
09D8-09DB  
09DE  
09E4-09E5  
09FB-0A01  
0A03-0A04  
0A0B-0A0E  
0A11-0A12  
0A29  
0A31  
0A34  
0A37  
0A3A-0A3B  
0A3D  
0A43-0A46  
0A49-0A4A  
0A4E-0A58  
0A5D  
0A5F-0A65  
0A75-0A80  
0A84  
0A8C  
0A8E  
0A92

0AA9  
0AB1  
0AB4  
0ABA-0ABB  
0AC6  
0ACA  
0ACE-0ACF  
0AD1-0ADF  
0AE1-0AE5  
0AF0-0B00  
0B04  
0B0D-0B0E  
0B11-0B12  
0B29  
0B31  
0B34-0B35  
0B3A-0B3B  
0B44-0B46  
0B49-0B4A  
0B4E-0B55  
0B58-0B5B  
0B5E  
0B62-0B65  
0B71-0B81  
0B84  
0B8B-0B8D  
0B91  
0B96-0B98  
0B9B  
0B9D  
0BA0-0BA2  
0BA5-0BA7  
0BAB-0BAD  
0BB6  
0BBA-0BBD  
0BC3-0BC5  
0BC9  
0BCE-0BD6  
0BD8-0BE6  
0BF3-0C00  
0C04  
0C0D  
0C11  
0C29  
0C34  
0C3A-0C3D  
0C45  
0C49  
0C4E-0C54  
0C57-0C5F  
0C62-0C65

0C70-0C81  
0C84  
0C8D  
0C91  
0CA9  
0CB4  
0CBA-0CBD  
0CC5  
0CC9  
0CCE-0CD4  
0CD7-0CDD  
0CDF  
0CE2-0CE5  
0CF0-0D01  
0D04  
0D0D  
0D11  
0D29  
0D3A-0D3D  
0D44-0D45  
0D49  
0D4E-0D56  
0D58-0D5F  
0D62-0D65  
0D70-0D81  
0D84  
0D97-0D99  
0DB2  
0DBC  
0DBE-0DBF  
0DC7-0DC9  
0DCB-0DCE  
0DD5  
0DD7  
0DE0-0DF1  
0DF5-0E00  
0E3B-0E3E  
0E5C-0E80  
0E83  
0E85-0E86  
0E89  
0E8B-0E8C  
0E8E-0E93  
0E98  
0EA0  
0EA4  
0EA6  
0EA8-0EA9  
0EAC  
0EBA  
0EBE-0EBF

0EC5  
0EC7  
0ECE-0ECF  
0EDA-0EDB  
0EDE-0EFF  
0F48  
0F6B-0F70  
0F8C-0F8F  
0F98  
0FBD  
0FCD-0FCE  
0FD0-0FFF  
1022  
1028  
102B  
1033-1035  
103A-103F  
105A-109F  
10C6-10CF  
10F7-10FA  
10FC-10FF  
115A-115E  
11A3-11A7  
11FA-11FF  
1207  
1247  
1249  
124E-124F  
1257  
1259  
125E-125F  
1287  
1289  
128E-128F  
12AF  
12B1  
12B6-12B7  
12BF  
12C1  
12C6-12C7  
12CF  
12D7  
12EF  
130F  
1311  
1316-1317  
131F  
1347  
135B-1360  
137D-139F  
13F5-1400

1677-167F  
169D-169F  
16F1-177F  
17DD-17DF  
17EA-17FF  
180F  
181A-181F  
1878-187F  
18AA-1DFF  
1E9C-1E9F  
1EFA-1EFF  
1F16-1F17  
1F1E-1F1F  
1F46-1F47  
1F4E-1F4F  
1F58  
1F5A  
1F5C  
1F5E  
1F7E-1F7F  
1FB5  
1FC5  
1FD4-1FD5  
1FDC  
1FF0-1FF1  
1FF5  
1FFF  
2047  
204E-2069  
2071-2073  
208F-209F  
20B0-20CF  
20E4-20FF  
213B-2152  
2184-218F  
21F4-21FF  
22F2-22FF  
237C  
239B-23FF  
2427-243F  
244B-245F  
24EB-24FF  
2596-259F  
25F8-25FF  
2614-2618  
2672-2700  
2705  
270A-270B  
2728  
274C  
274E

2753-2755  
2757  
275F-2760  
2768-2775  
2795-2797  
27B0  
27BF-27FF  
2900-2E7F  
2E9A  
2EF4-2EFF  
2FD6-2FEF  
2FFC-2FFF  
303B-303D  
3040  
3095-3098  
309F-30A0  
30FF-3104  
312D-3130  
318F  
31B8-31FF  
321D-321F  
3244-325F  
327C-327E  
32B1-32BF  
32CC-32CF  
32FF  
3377-337A  
33DE-33DF  
33FF  
4DB6-4DFF  
9FA6-9FFF  
A48D-A48F  
A4A2-A4A3  
A4B4  
A4C1  
A4C5  
A4C7-ABFF  
D7A4-D7FF  
FA2E-FAFF  
FB07-FB12  
FB18-FB1C  
FB37  
FB3D  
FB3F  
FB42  
FB45  
FBB2-FBD2  
FD40-FD4F  
FD90-FD91  
FDC8-FDCF  
FDFC-FE1F

FE24-FE2F  
FE45-FE48  
FE53  
FE67  
FE6C-FE6F  
FE73  
FE75  
FEFD-FEFE  
FF00  
FF5F-FF60  
FFBF-FFC1  
FFC8-FFC9  
FFD0-FFD1  
FFD8-FFD9  
FFDD-FFDF  
FFE7  
FFEF-FFF8  
10000-102FF  
1031F  
10324-1032F  
1034B-103FF  
10426-10427  
1044E-1CFFF  
1D0F6-1D0FF  
1D127-1D129  
1D1DE-1D3FF  
1D455  
1D49D  
1D4A0-1D4A1  
1D4A3-1D4A4  
1D4A7-1D4A8  
1D4AD  
1D4BA  
1D4BC  
1D4C1  
1D4C4  
1D506  
1D50B-1D50C  
1D515  
1D51D  
1D53A  
1D53F  
1D545  
1D547-1D549  
1D551  
1D6A4-1D6A7  
1D7CA-1D7CD  
1D800-1FFFD  
2A6D7-2F7FF  
2FA1E-2FFFD  
30000-3FFFD



```

40000-4FFFD
50000-5FFFD
60000-6FFFD
70000-7FFFD
80000-8FFFD
90000-9FFFD
A0000-AFFFD
B0000-BFFFD
C0000-CFFFD
D0000-DFFFD
E0000
E0002-E001F
E0080-EFFFD
----- End Table A.1 -----

```

## [B.](#) Mapping Tables

The following is the mapping table from [Section 3](#). The table has three columns:

- the code point that is mapped from
- the zero or more code points that it is mapped to
- the reason for the mapping

The columns are separated by semicolons. Note that the second column may be empty, or it may have one code point, or it may have more than one code point, with each code point separated by a space.

### [B.1](#) Commonly mapped to nothing

```

----- Start Table B.1 -----
00AD; ; Map to nothing
1806; ; Map to nothing
180B; ; Map to nothing
180C; ; Map to nothing
180D; ; Map to nothing
200B; ; Map to nothing
200C; ; Map to nothing
200D; ; Map to nothing
FEFF; ; Map to nothing
----- End Table B.1 -----

```

### [B.2](#) Mapping for lowercase used with NFKC

```

----- Start Table B.2 -----
0041; 0061; Case map
0042; 0062; Case map
0043; 0063; Case map
0044; 0064; Case map
0045; 0065; Case map
0046; 0066; Case map
0047; 0067; Case map
0048; 0068; Case map

```

0049; 0069; Case map  
004A; 006A; Case map  
004B; 006B; Case map  
004C; 006C; Case map  
004D; 006D; Case map  
004E; 006E; Case map  
004F; 006F; Case map  
0050; 0070; Case map  
0051; 0071; Case map  
0052; 0072; Case map  
0053; 0073; Case map  
0054; 0074; Case map  
0055; 0075; Case map  
0056; 0076; Case map  
0057; 0077; Case map  
0058; 0078; Case map  
0059; 0079; Case map  
005A; 007A; Case map  
00B5; 03BC; Case map  
00C0; 00E0; Case map  
00C1; 00E1; Case map  
00C2; 00E2; Case map  
00C3; 00E3; Case map  
00C4; 00E4; Case map  
00C5; 00E5; Case map  
00C6; 00E6; Case map  
00C7; 00E7; Case map  
00C8; 00E8; Case map  
00C9; 00E9; Case map  
00CA; 00EA; Case map  
00CB; 00EB; Case map  
00CC; 00EC; Case map  
00CD; 00ED; Case map  
00CE; 00EE; Case map  
00CF; 00EF; Case map  
00D0; 00F0; Case map  
00D1; 00F1; Case map  
00D2; 00F2; Case map  
00D3; 00F3; Case map  
00D4; 00F4; Case map  
00D5; 00F5; Case map  
00D6; 00F6; Case map  
00D8; 00F8; Case map  
00D9; 00F9; Case map  
00DA; 00FA; Case map  
00DB; 00FB; Case map  
00DC; 00FC; Case map  
00DD; 00FD; Case map  
00DE; 00FE; Case map  
00DF; 0073 0073; Case map  
0100; 0101; Case map

0102; 0103; Case map  
0104; 0105; Case map  
0106; 0107; Case map  
0108; 0109; Case map  
010A; 010B; Case map  
010C; 010D; Case map  
010E; 010F; Case map  
0110; 0111; Case map  
0112; 0113; Case map  
0114; 0115; Case map  
0116; 0117; Case map  
0118; 0119; Case map  
011A; 011B; Case map  
011C; 011D; Case map  
011E; 011F; Case map  
0120; 0121; Case map  
0122; 0123; Case map  
0124; 0125; Case map  
0126; 0127; Case map  
0128; 0129; Case map  
012A; 012B; Case map  
012C; 012D; Case map  
012E; 012F; Case map  
0130; 0069; Case map  
0131; 0069; Case map  
0132; 0133; Case map  
0134; 0135; Case map  
0136; 0137; Case map  
0139; 013A; Case map  
013B; 013C; Case map  
013D; 013E; Case map  
013F; 0140; Case map  
0141; 0142; Case map  
0143; 0144; Case map  
0145; 0146; Case map  
0147; 0148; Case map  
0149; 02BC 006E; Case map  
014A; 014B; Case map  
014C; 014D; Case map  
014E; 014F; Case map  
0150; 0151; Case map  
0152; 0153; Case map  
0154; 0155; Case map  
0156; 0157; Case map  
0158; 0159; Case map  
015A; 015B; Case map  
015C; 015D; Case map  
015E; 015F; Case map  
0160; 0161; Case map  
0162; 0163; Case map  
0164; 0165; Case map

0166; 0167; Case map  
0168; 0169; Case map  
016A; 016B; Case map  
016C; 016D; Case map  
016E; 016F; Case map  
0170; 0171; Case map  
0172; 0173; Case map  
0174; 0175; Case map  
0176; 0177; Case map  
0178; 00FF; Case map  
0179; 017A; Case map  
017B; 017C; Case map  
017D; 017E; Case map  
017F; 0073; Case map  
0181; 0253; Case map  
0182; 0183; Case map  
0184; 0185; Case map  
0186; 0254; Case map  
0187; 0188; Case map  
0189; 0256; Case map  
018A; 0257; Case map  
018B; 018C; Case map  
018E; 01DD; Case map  
018F; 0259; Case map  
0190; 025B; Case map  
0191; 0192; Case map  
0193; 0260; Case map  
0194; 0263; Case map  
0196; 0269; Case map  
0197; 0268; Case map  
0198; 0199; Case map  
019C; 026F; Case map  
019D; 0272; Case map  
019F; 0275; Case map  
01A0; 01A1; Case map  
01A2; 01A3; Case map  
01A4; 01A5; Case map  
01A6; 0280; Case map  
01A7; 01A8; Case map  
01A9; 0283; Case map  
01AC; 01AD; Case map  
01AE; 0288; Case map  
01AF; 01B0; Case map  
01B1; 028A; Case map  
01B2; 028B; Case map  
01B3; 01B4; Case map  
01B5; 01B6; Case map  
01B7; 0292; Case map  
01B8; 01B9; Case map  
01BC; 01BD; Case map  
01C4; 01C6; Case map

01C5; 01C6; Case map  
01C7; 01C9; Case map  
01C8; 01C9; Case map  
01CA; 01CC; Case map  
01CB; 01CC; Case map  
01CD; 01CE; Case map  
01CF; 01D0; Case map  
01D1; 01D2; Case map  
01D3; 01D4; Case map  
01D5; 01D6; Case map  
01D7; 01D8; Case map  
01D9; 01DA; Case map  
01DB; 01DC; Case map  
01DE; 01DF; Case map  
01E0; 01E1; Case map  
01E2; 01E3; Case map  
01E4; 01E5; Case map  
01E6; 01E7; Case map  
01E8; 01E9; Case map  
01EA; 01EB; Case map  
01EC; 01ED; Case map  
01EE; 01EF; Case map  
01F0; 006A 030C; Case map  
01F1; 01F3; Case map  
01F2; 01F3; Case map  
01F4; 01F5; Case map  
01F6; 0195; Case map  
01F7; 01BF; Case map  
01F8; 01F9; Case map  
01FA; 01FB; Case map  
01FC; 01FD; Case map  
01FE; 01FF; Case map  
0200; 0201; Case map  
0202; 0203; Case map  
0204; 0205; Case map  
0206; 0207; Case map  
0208; 0209; Case map  
020A; 020B; Case map  
020C; 020D; Case map  
020E; 020F; Case map  
0210; 0211; Case map  
0212; 0213; Case map  
0214; 0215; Case map  
0216; 0217; Case map  
0218; 0219; Case map  
021A; 021B; Case map  
021C; 021D; Case map  
021E; 021F; Case map  
0222; 0223; Case map  
0224; 0225; Case map  
0226; 0227; Case map

0228; 0229; Case map  
022A; 022B; Case map  
022C; 022D; Case map  
022E; 022F; Case map  
0230; 0231; Case map  
0232; 0233; Case map  
0345; 03B9; Case map  
037A; 0020 03B9; Additional folding  
0386; 03AC; Case map  
0388; 03AD; Case map  
0389; 03AE; Case map  
038A; 03AF; Case map  
038C; 03CC; Case map  
038E; 03CD; Case map  
038F; 03CE; Case map  
0390; 03B9 0308 0301; Case map  
0391; 03B1; Case map  
0392; 03B2; Case map  
0393; 03B3; Case map  
0394; 03B4; Case map  
0395; 03B5; Case map  
0396; 03B6; Case map  
0397; 03B7; Case map  
0398; 03B8; Case map  
0399; 03B9; Case map  
039A; 03BA; Case map  
039B; 03BB; Case map  
039C; 03BC; Case map  
039D; 03BD; Case map  
039E; 03BE; Case map  
039F; 03BF; Case map  
03A0; 03C0; Case map  
03A1; 03C1; Case map  
03A3; 03C3; Case map  
03A4; 03C4; Case map  
03A5; 03C5; Case map  
03A6; 03C6; Case map  
03A7; 03C7; Case map  
03A8; 03C8; Case map  
03A9; 03C9; Case map  
03AA; 03CA; Case map  
03AB; 03CB; Case map  
03B0; 03C5 0308 0301; Case map  
03C2; 03C3; Case map  
03D0; 03B2; Case map  
03D1; 03B8; Case map  
03D2; 03C5; Additional folding  
03D3; 03CD; Additional folding  
03D4; 03CB; Additional folding  
03D5; 03C6; Case map  
03D6; 03C0; Case map

03DA; 03DB; Case map  
03DC; 03DD; Case map  
03DE; 03DF; Case map  
03E0; 03E1; Case map  
03E2; 03E3; Case map  
03E4; 03E5; Case map  
03E6; 03E7; Case map  
03E8; 03E9; Case map  
03EA; 03EB; Case map  
03EC; 03ED; Case map  
03EE; 03EF; Case map  
03F0; 03BA; Case map  
03F1; 03C1; Case map  
03F2; 03C3; Case map  
03F4; 03B8; Case map  
03F5; 03B5; Case map  
0400; 0450; Case map  
0401; 0451; Case map  
0402; 0452; Case map  
0403; 0453; Case map  
0404; 0454; Case map  
0405; 0455; Case map  
0406; 0456; Case map  
0407; 0457; Case map  
0408; 0458; Case map  
0409; 0459; Case map  
040A; 045A; Case map  
040B; 045B; Case map  
040C; 045C; Case map  
040D; 045D; Case map  
040E; 045E; Case map  
040F; 045F; Case map  
0410; 0430; Case map  
0411; 0431; Case map  
0412; 0432; Case map  
0413; 0433; Case map  
0414; 0434; Case map  
0415; 0435; Case map  
0416; 0436; Case map  
0417; 0437; Case map  
0418; 0438; Case map  
0419; 0439; Case map  
041A; 043A; Case map  
041B; 043B; Case map  
041C; 043C; Case map  
041D; 043D; Case map  
041E; 043E; Case map  
041F; 043F; Case map  
0420; 0440; Case map  
0421; 0441; Case map  
0422; 0442; Case map

0423; 0443; Case map  
0424; 0444; Case map  
0425; 0445; Case map  
0426; 0446; Case map  
0427; 0447; Case map  
0428; 0448; Case map  
0429; 0449; Case map  
042A; 044A; Case map  
042B; 044B; Case map  
042C; 044C; Case map  
042D; 044D; Case map  
042E; 044E; Case map  
042F; 044F; Case map  
0460; 0461; Case map  
0462; 0463; Case map  
0464; 0465; Case map  
0466; 0467; Case map  
0468; 0469; Case map  
046A; 046B; Case map  
046C; 046D; Case map  
046E; 046F; Case map  
0470; 0471; Case map  
0472; 0473; Case map  
0474; 0475; Case map  
0476; 0477; Case map  
0478; 0479; Case map  
047A; 047B; Case map  
047C; 047D; Case map  
047E; 047F; Case map  
0480; 0481; Case map  
048C; 048D; Case map  
048E; 048F; Case map  
0490; 0491; Case map  
0492; 0493; Case map  
0494; 0495; Case map  
0496; 0497; Case map  
0498; 0499; Case map  
049A; 049B; Case map  
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1D473; 006C; Additional folding  
1D474; 006D; Additional folding  
1D475; 006E; Additional folding  
1D476; 006F; Additional folding  
1D477; 0070; Additional folding  
1D478; 0071; Additional folding  
1D479; 0072; Additional folding

1D47A; 0073; Additional folding  
1D47B; 0074; Additional folding  
1D47C; 0075; Additional folding  
1D47D; 0076; Additional folding  
1D47E; 0077; Additional folding  
1D47F; 0078; Additional folding  
1D480; 0079; Additional folding  
1D481; 007A; Additional folding  
1D49C; 0061; Additional folding  
1D49E; 0063; Additional folding  
1D49F; 0064; Additional folding  
1D4A2; 0067; Additional folding  
1D4A5; 006A; Additional folding  
1D4A6; 006B; Additional folding  
1D4A9; 006E; Additional folding  
1D4AA; 006F; Additional folding  
1D4AB; 0070; Additional folding  
1D4AC; 0071; Additional folding  
1D4AE; 0073; Additional folding  
1D4AF; 0074; Additional folding  
1D4B0; 0075; Additional folding  
1D4B1; 0076; Additional folding  
1D4B2; 0077; Additional folding  
1D4B3; 0078; Additional folding  
1D4B4; 0079; Additional folding  
1D4B5; 007A; Additional folding  
1D4D0; 0061; Additional folding  
1D4D1; 0062; Additional folding  
1D4D2; 0063; Additional folding  
1D4D3; 0064; Additional folding  
1D4D4; 0065; Additional folding  
1D4D5; 0066; Additional folding  
1D4D6; 0067; Additional folding  
1D4D7; 0068; Additional folding  
1D4D8; 0069; Additional folding  
1D4D9; 006A; Additional folding  
1D4DA; 006B; Additional folding  
1D4DB; 006C; Additional folding  
1D4DC; 006D; Additional folding  
1D4DD; 006E; Additional folding  
1D4DE; 006F; Additional folding  
1D4DF; 0070; Additional folding  
1D4E0; 0071; Additional folding  
1D4E1; 0072; Additional folding  
1D4E2; 0073; Additional folding  
1D4E3; 0074; Additional folding  
1D4E4; 0075; Additional folding  
1D4E5; 0076; Additional folding  
1D4E6; 0077; Additional folding  
1D4E7; 0078; Additional folding  
1D4E8; 0079; Additional folding

1D4E9; 007A; Additional folding  
1D504; 0061; Additional folding  
1D505; 0062; Additional folding  
1D507; 0064; Additional folding  
1D508; 0065; Additional folding  
1D509; 0066; Additional folding  
1D50A; 0067; Additional folding  
1D50D; 006A; Additional folding  
1D50E; 006B; Additional folding  
1D50F; 006C; Additional folding  
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1D511; 006E; Additional folding  
1D512; 006F; Additional folding  
1D513; 0070; Additional folding  
1D514; 0071; Additional folding  
1D516; 0073; Additional folding  
1D517; 0074; Additional folding  
1D518; 0075; Additional folding  
1D519; 0076; Additional folding  
1D51A; 0077; Additional folding  
1D51B; 0078; Additional folding  
1D51C; 0079; Additional folding  
1D538; 0061; Additional folding  
1D539; 0062; Additional folding  
1D53B; 0064; Additional folding  
1D53C; 0065; Additional folding  
1D53D; 0066; Additional folding  
1D53E; 0067; Additional folding  
1D540; 0069; Additional folding  
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1D542; 006B; Additional folding  
1D543; 006C; Additional folding  
1D544; 006D; Additional folding  
1D546; 006F; Additional folding  
1D54A; 0073; Additional folding  
1D54B; 0074; Additional folding  
1D54C; 0075; Additional folding  
1D54D; 0076; Additional folding  
1D54E; 0077; Additional folding  
1D54F; 0078; Additional folding  
1D550; 0079; Additional folding  
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1D56D; 0062; Additional folding  
1D56E; 0063; Additional folding  
1D56F; 0064; Additional folding  
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1D572; 0067; Additional folding  
1D573; 0068; Additional folding  
1D574; 0069; Additional folding  
1D575; 006A; Additional folding

1D576; 006B; Additional folding  
1D577; 006C; Additional folding  
1D578; 006D; Additional folding  
1D579; 006E; Additional folding  
1D57A; 006F; Additional folding  
1D57B; 0070; Additional folding  
1D57C; 0071; Additional folding  
1D57D; 0072; Additional folding  
1D57E; 0073; Additional folding  
1D57F; 0074; Additional folding  
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1D582; 0077; Additional folding  
1D583; 0078; Additional folding  
1D584; 0079; Additional folding  
1D585; 007A; Additional folding  
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1D5A2; 0063; Additional folding  
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1D5A6; 0067; Additional folding  
1D5A7; 0068; Additional folding  
1D5A8; 0069; Additional folding  
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1D5AA; 006B; Additional folding  
1D5AB; 006C; Additional folding  
1D5AC; 006D; Additional folding  
1D5AD; 006E; Additional folding  
1D5AE; 006F; Additional folding  
1D5AF; 0070; Additional folding  
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1D5B1; 0072; Additional folding  
1D5B2; 0073; Additional folding  
1D5B3; 0074; Additional folding  
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1D5B5; 0076; Additional folding  
1D5B6; 0077; Additional folding  
1D5B7; 0078; Additional folding  
1D5B8; 0079; Additional folding  
1D5B9; 007A; Additional folding  
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1D5D5; 0062; Additional folding  
1D5D6; 0063; Additional folding  
1D5D7; 0064; Additional folding  
1D5D8; 0065; Additional folding  
1D5D9; 0066; Additional folding  
1D5DA; 0067; Additional folding  
1D5DB; 0068; Additional folding  
1D5DC; 0069; Additional folding

1D5DD; 006A; Additional folding  
1D5DE; 006B; Additional folding  
1D5DF; 006C; Additional folding  
1D5E0; 006D; Additional folding  
1D5E1; 006E; Additional folding  
1D5E2; 006F; Additional folding  
1D5E3; 0070; Additional folding  
1D5E4; 0071; Additional folding  
1D5E5; 0072; Additional folding  
1D5E6; 0073; Additional folding  
1D5E7; 0074; Additional folding  
1D5E8; 0075; Additional folding  
1D5E9; 0076; Additional folding  
1D5EA; 0077; Additional folding  
1D5EB; 0078; Additional folding  
1D5EC; 0079; Additional folding  
1D5ED; 007A; Additional folding  
1D608; 0061; Additional folding  
1D609; 0062; Additional folding  
1D60A; 0063; Additional folding  
1D60B; 0064; Additional folding  
1D60C; 0065; Additional folding  
1D60D; 0066; Additional folding  
1D60E; 0067; Additional folding  
1D60F; 0068; Additional folding  
1D610; 0069; Additional folding  
1D611; 006A; Additional folding  
1D612; 006B; Additional folding  
1D613; 006C; Additional folding  
1D614; 006D; Additional folding  
1D615; 006E; Additional folding  
1D616; 006F; Additional folding  
1D617; 0070; Additional folding  
1D618; 0071; Additional folding  
1D619; 0072; Additional folding  
1D61A; 0073; Additional folding  
1D61B; 0074; Additional folding  
1D61C; 0075; Additional folding  
1D61D; 0076; Additional folding  
1D61E; 0077; Additional folding  
1D61F; 0078; Additional folding  
1D620; 0079; Additional folding  
1D621; 007A; Additional folding  
1D63C; 0061; Additional folding  
1D63D; 0062; Additional folding  
1D63E; 0063; Additional folding  
1D63F; 0064; Additional folding  
1D640; 0065; Additional folding  
1D641; 0066; Additional folding  
1D642; 0067; Additional folding  
1D643; 0068; Additional folding



1D644; 0069; Additional folding  
1D645; 006A; Additional folding  
1D646; 006B; Additional folding  
1D647; 006C; Additional folding  
1D648; 006D; Additional folding  
1D649; 006E; Additional folding  
1D64A; 006F; Additional folding  
1D64B; 0070; Additional folding  
1D64C; 0071; Additional folding  
1D64D; 0072; Additional folding  
1D64E; 0073; Additional folding  
1D64F; 0074; Additional folding  
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1D651; 0076; Additional folding  
1D652; 0077; Additional folding  
1D653; 0078; Additional folding  
1D654; 0079; Additional folding  
1D655; 007A; Additional folding  
1D670; 0061; Additional folding  
1D671; 0062; Additional folding  
1D672; 0063; Additional folding  
1D673; 0064; Additional folding  
1D674; 0065; Additional folding  
1D675; 0066; Additional folding  
1D676; 0067; Additional folding  
1D677; 0068; Additional folding  
1D678; 0069; Additional folding  
1D679; 006A; Additional folding  
1D67A; 006B; Additional folding  
1D67B; 006C; Additional folding  
1D67C; 006D; Additional folding  
1D67D; 006E; Additional folding  
1D67E; 006F; Additional folding  
1D67F; 0070; Additional folding  
1D680; 0071; Additional folding  
1D681; 0072; Additional folding  
1D682; 0073; Additional folding  
1D683; 0074; Additional folding  
1D684; 0075; Additional folding  
1D685; 0076; Additional folding  
1D686; 0077; Additional folding  
1D687; 0078; Additional folding  
1D688; 0079; Additional folding  
1D689; 007A; Additional folding  
1D6A8; 03B1; Additional folding  
1D6A9; 03B2; Additional folding  
1D6AA; 03B3; Additional folding  
1D6AB; 03B4; Additional folding  
1D6AC; 03B5; Additional folding  
1D6AD; 03B6; Additional folding  
1D6AE; 03B7; Additional folding

1D6AF; 03B8; Additional folding  
1D6B0; 03B9; Additional folding  
1D6B1; 03BA; Additional folding  
1D6B2; 03BB; Additional folding  
1D6B3; 03BC; Additional folding  
1D6B4; 03BD; Additional folding  
1D6B5; 03BE; Additional folding  
1D6B6; 03BF; Additional folding  
1D6B7; 03C0; Additional folding  
1D6B8; 03C1; Additional folding  
1D6B9; 03B8; Additional folding  
1D6BA; 03C3; Additional folding  
1D6BB; 03C4; Additional folding  
1D6BC; 03C5; Additional folding  
1D6BD; 03C6; Additional folding  
1D6BE; 03C7; Additional folding  
1D6BF; 03C8; Additional folding  
1D6C0; 03C9; Additional folding  
1D6D3; 03C3; Additional folding  
1D6E2; 03B1; Additional folding  
1D6E3; 03B2; Additional folding  
1D6E4; 03B3; Additional folding  
1D6E5; 03B4; Additional folding  
1D6E6; 03B5; Additional folding  
1D6E7; 03B6; Additional folding  
1D6E8; 03B7; Additional folding  
1D6E9; 03B8; Additional folding  
1D6EA; 03B9; Additional folding  
1D6EB; 03BA; Additional folding  
1D6EC; 03BB; Additional folding  
1D6ED; 03BC; Additional folding  
1D6EE; 03BD; Additional folding  
1D6EF; 03BE; Additional folding  
1D6F0; 03BF; Additional folding  
1D6F1; 03C0; Additional folding  
1D6F2; 03C1; Additional folding  
1D6F3; 03B8; Additional folding  
1D6F4; 03C3; Additional folding  
1D6F5; 03C4; Additional folding  
1D6F6; 03C5; Additional folding  
1D6F7; 03C6; Additional folding  
1D6F8; 03C7; Additional folding  
1D6F9; 03C8; Additional folding  
1D6FA; 03C9; Additional folding  
1D70D; 03C3; Additional folding  
1D71C; 03B1; Additional folding  
1D71D; 03B2; Additional folding  
1D71E; 03B3; Additional folding  
1D71F; 03B4; Additional folding  
1D720; 03B5; Additional folding  
1D721; 03B6; Additional folding

1D722; 03B7; Additional folding  
1D723; 03B8; Additional folding  
1D724; 03B9; Additional folding  
1D725; 03BA; Additional folding  
1D726; 03BB; Additional folding  
1D727; 03BC; Additional folding  
1D728; 03BD; Additional folding  
1D729; 03BE; Additional folding  
1D72A; 03BF; Additional folding  
1D72B; 03C0; Additional folding  
1D72C; 03C1; Additional folding  
1D72D; 03B8; Additional folding  
1D72E; 03C3; Additional folding  
1D72F; 03C4; Additional folding  
1D730; 03C5; Additional folding  
1D731; 03C6; Additional folding  
1D732; 03C7; Additional folding  
1D733; 03C8; Additional folding  
1D734; 03C9; Additional folding  
1D747; 03C3; Additional folding  
1D756; 03B1; Additional folding  
1D757; 03B2; Additional folding  
1D758; 03B3; Additional folding  
1D759; 03B4; Additional folding  
1D75A; 03B5; Additional folding  
1D75B; 03B6; Additional folding  
1D75C; 03B7; Additional folding  
1D75D; 03B8; Additional folding  
1D75E; 03B9; Additional folding  
1D75F; 03BA; Additional folding  
1D760; 03BB; Additional folding  
1D761; 03BC; Additional folding  
1D762; 03BD; Additional folding  
1D763; 03BE; Additional folding  
1D764; 03BF; Additional folding  
1D765; 03C0; Additional folding  
1D766; 03C1; Additional folding  
1D767; 03B8; Additional folding  
1D768; 03C3; Additional folding  
1D769; 03C4; Additional folding  
1D76A; 03C5; Additional folding  
1D76B; 03C6; Additional folding  
1D76C; 03C7; Additional folding  
1D76D; 03C8; Additional folding  
1D76E; 03C9; Additional folding  
1D781; 03C3; Additional folding  
1D790; 03B1; Additional folding  
1D791; 03B2; Additional folding  
1D792; 03B3; Additional folding  
1D793; 03B4; Additional folding  
1D794; 03B5; Additional folding

1D795; 03B6; Additional folding  
1D796; 03B7; Additional folding  
1D797; 03B8; Additional folding  
1D798; 03B9; Additional folding  
1D799; 03BA; Additional folding  
1D79A; 03BB; Additional folding  
1D79B; 03BC; Additional folding  
1D79C; 03BD; Additional folding  
1D79D; 03BE; Additional folding  
1D79E; 03BF; Additional folding  
1D79F; 03C0; Additional folding  
1D7A0; 03C1; Additional folding  
1D7A1; 03B8; Additional folding  
1D7A2; 03C3; Additional folding  
1D7A3; 03C4; Additional folding  
1D7A4; 03C5; Additional folding  
1D7A5; 03C6; Additional folding  
1D7A6; 03C7; Additional folding  
1D7A7; 03C8; Additional folding  
1D7A8; 03C9; Additional folding  
1D7BB; 03C3; Additional folding  
----- End Table B.2 -----

### [B.3](#) Mapping for lowercase used with no normalization

----- Start Table B.3 -----

0041; 0061; Case map  
0042; 0062; Case map  
0043; 0063; Case map  
0044; 0064; Case map  
0045; 0065; Case map  
0046; 0066; Case map  
0047; 0067; Case map  
0048; 0068; Case map  
0049; 0069; Case map  
004A; 006A; Case map  
004B; 006B; Case map  
004C; 006C; Case map  
004D; 006D; Case map  
004E; 006E; Case map  
004F; 006F; Case map  
0050; 0070; Case map  
0051; 0071; Case map  
0052; 0072; Case map  
0053; 0073; Case map  
0054; 0074; Case map  
0055; 0075; Case map  
0056; 0076; Case map  
0057; 0077; Case map  
0058; 0078; Case map  
0059; 0079; Case map

005A; 007A; Case map  
00B5; 03BC; Case map  
00C0; 00E0; Case map  
00C1; 00E1; Case map  
00C2; 00E2; Case map  
00C3; 00E3; Case map  
00C4; 00E4; Case map  
00C5; 00E5; Case map  
00C6; 00E6; Case map  
00C7; 00E7; Case map  
00C8; 00E8; Case map  
00C9; 00E9; Case map  
00CA; 00EA; Case map  
00CB; 00EB; Case map  
00CC; 00EC; Case map  
00CD; 00ED; Case map  
00CE; 00EE; Case map  
00CF; 00EF; Case map  
00D0; 00F0; Case map  
00D1; 00F1; Case map  
00D2; 00F2; Case map  
00D3; 00F3; Case map  
00D4; 00F4; Case map  
00D5; 00F5; Case map  
00D6; 00F6; Case map  
00D8; 00F8; Case map  
00D9; 00F9; Case map  
00DA; 00FA; Case map  
00DB; 00FB; Case map  
00DC; 00FC; Case map  
00DD; 00FD; Case map  
00DE; 00FE; Case map  
00DF; 0073 0073; Case map  
0100; 0101; Case map  
0102; 0103; Case map  
0104; 0105; Case map  
0106; 0107; Case map  
0108; 0109; Case map  
010A; 010B; Case map  
010C; 010D; Case map  
010E; 010F; Case map  
0110; 0111; Case map  
0112; 0113; Case map  
0114; 0115; Case map  
0116; 0117; Case map  
0118; 0119; Case map  
011A; 011B; Case map  
011C; 011D; Case map  
011E; 011F; Case map  
0120; 0121; Case map  
0122; 0123; Case map

0124; 0125; Case map  
0126; 0127; Case map  
0128; 0129; Case map  
012A; 012B; Case map  
012C; 012D; Case map  
012E; 012F; Case map  
0130; 0069; Case map  
0131; 0069; Case map  
0132; 0133; Case map  
0134; 0135; Case map  
0136; 0137; Case map  
0139; 013A; Case map  
013B; 013C; Case map  
013D; 013E; Case map  
013F; 0140; Case map  
0141; 0142; Case map  
0143; 0144; Case map  
0145; 0146; Case map  
0147; 0148; Case map  
0149; 02BC 006E; Case map  
014A; 014B; Case map  
014C; 014D; Case map  
014E; 014F; Case map  
0150; 0151; Case map  
0152; 0153; Case map  
0154; 0155; Case map  
0156; 0157; Case map  
0158; 0159; Case map  
015A; 015B; Case map  
015C; 015D; Case map  
015E; 015F; Case map  
0160; 0161; Case map  
0162; 0163; Case map  
0164; 0165; Case map  
0166; 0167; Case map  
0168; 0169; Case map  
016A; 016B; Case map  
016C; 016D; Case map  
016E; 016F; Case map  
0170; 0171; Case map  
0172; 0173; Case map  
0174; 0175; Case map  
0176; 0177; Case map  
0178; 00FF; Case map  
0179; 017A; Case map  
017B; 017C; Case map  
017D; 017E; Case map  
017F; 0073; Case map  
0181; 0253; Case map  
0182; 0183; Case map  
0184; 0185; Case map

0186; 0254; Case map  
0187; 0188; Case map  
0189; 0256; Case map  
018A; 0257; Case map  
018B; 018C; Case map  
018E; 01DD; Case map  
018F; 0259; Case map  
0190; 025B; Case map  
0191; 0192; Case map  
0193; 0260; Case map  
0194; 0263; Case map  
0196; 0269; Case map  
0197; 0268; Case map  
0198; 0199; Case map  
019C; 026F; Case map  
019D; 0272; Case map  
019F; 0275; Case map  
01A0; 01A1; Case map  
01A2; 01A3; Case map  
01A4; 01A5; Case map  
01A6; 0280; Case map  
01A7; 01A8; Case map  
01A9; 0283; Case map  
01AC; 01AD; Case map  
01AE; 0288; Case map  
01AF; 01B0; Case map  
01B1; 028A; Case map  
01B2; 028B; Case map  
01B3; 01B4; Case map  
01B5; 01B6; Case map  
01B7; 0292; Case map  
01B8; 01B9; Case map  
01BC; 01BD; Case map  
01C4; 01C6; Case map  
01C5; 01C6; Case map  
01C7; 01C9; Case map  
01C8; 01C9; Case map  
01CA; 01CC; Case map  
01CB; 01CC; Case map  
01CD; 01CE; Case map  
01CF; 01D0; Case map  
01D1; 01D2; Case map  
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01D5; 01D6; Case map  
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01DE; 01DF; Case map  
01E0; 01E1; Case map  
01E2; 01E3; Case map  
01E4; 01E5; Case map

01E6; 01E7; Case map  
01E8; 01E9; Case map  
01EA; 01EB; Case map  
01EC; 01ED; Case map  
01EE; 01EF; Case map  
01F0; 006A 030C; Case map  
01F1; 01F3; Case map  
01F2; 01F3; Case map  
01F4; 01F5; Case map  
01F6; 0195; Case map  
01F7; 01BF; Case map  
01F8; 01F9; Case map  
01FA; 01FB; Case map  
01FC; 01FD; Case map  
01FE; 01FF; Case map  
0200; 0201; Case map  
0202; 0203; Case map  
0204; 0205; Case map  
0206; 0207; Case map  
0208; 0209; Case map  
020A; 020B; Case map  
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020E; 020F; Case map  
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021A; 021B; Case map  
021C; 021D; Case map  
021E; 021F; Case map  
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0228; 0229; Case map  
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022C; 022D; Case map  
022E; 022F; Case map  
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0232; 0233; Case map  
0345; 03B9; Case map  
0386; 03AC; Case map  
0388; 03AD; Case map  
0389; 03AE; Case map  
038A; 03AF; Case map  
038C; 03CC; Case map  
038E; 03CD; Case map  
038F; 03CE; Case map  
0390; 03B9 0308 0301; Case map  
0391; 03B1; Case map  
0392; 03B2; Case map



0393; 03B3; Case map  
0394; 03B4; Case map  
0395; 03B5; Case map  
0396; 03B6; Case map  
0397; 03B7; Case map  
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0399; 03B9; Case map  
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039B; 03BB; Case map  
039C; 03BC; Case map  
039D; 03BD; Case map  
039E; 03BE; Case map  
039F; 03BF; Case map  
03A0; 03C0; Case map  
03A1; 03C1; Case map  
03A3; 03C3; Case map  
03A4; 03C4; Case map  
03A5; 03C5; Case map  
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03A9; 03C9; Case map  
03AA; 03CA; Case map  
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1FF7; 03C9 0342 03B9; Case map  
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FF2B; FF4B; Case map  
FF2C; FF4C; Case map  
FF2D; FF4D; Case map  
FF2E; FF4E; Case map  
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1041C; 10444; Case map
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1041F; 10447; Case map
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10423; 1044B; Case map
10424; 1044C; Case map
10425; 1044D; Case map
----- End Table B.3 -----

```

## C. Prohibition tables

The tables in this appendix consist of lines with one prohibited code point per line. The format of the lines are the value of the code point, a semicolon, and a comment which is the name of the code point.

### C.1 Space characters

```

----- Start Table C.1 -----
00A0; NO-BREAK SPACE
1680; OGHAM SPACE MARK
2000; EN QUAD
2001; EM QUAD
2002; EN SPACE

```

2003; EM SPACE  
2004; THREE-PER-EM SPACE  
2005; FOUR-PER-EM SPACE  
2006; SIX-PER-EM SPACE  
2007; FIGURE SPACE  
2008; PUNCTUATION SPACE  
2009; THIN SPACE  
200A; HAIR SPACE  
202F; NARROW NO-BREAK SPACE  
3000; IDEOGRAPHIC SPACE  
----- End Table C.1 -----

## [C.2](#) Control characters

----- Start Table C.2 -----  
0080-009F; [CONTROL CHARACTERS]  
070F; SYRIAC ABBREVIATION MARK  
180E; MONGOLIAN VOWEL SEPARATOR  
2028; LINE SEPARATOR  
2029; PARAGRAPH SEPARATOR  
206A-206F; [CONTROL CHARACTERS]  
FFF9-FFFC; [CONTROL CHARACTERS]  
1D173-1D17A; [MUSICAL CONTROL CHARACTERS]  
----- End Table C.2 -----

## [C.3](#) Private use and replacement characters

----- Start Table C.3 -----  
E000-F8FF; [PRIVATE USE, PLANE 0]  
F0000-FFFFD; [PRIVATE USE, PLANE 15]  
100000-10FFFFD; [PRIVATE USE, PLANE 16]  
FFFD; REPLACEMENT CHARACTER  
----- End Table C.3 -----

## [C.4](#) Non-character code points

----- Start Table C.4 -----  
FDD0-FDEF; [NONCHARACTER CODE POINTS]  
FFFE-FFFF; [NONCHARACTER CODE POINTS]  
1FFFE-1FFFF; [NONCHARACTER CODE POINTS]  
2FFFE-2FFFF; [NONCHARACTER CODE POINTS]  
3FFFE-3FFFF; [NONCHARACTER CODE POINTS]  
4FFFE-4FFFF; [NONCHARACTER CODE POINTS]  
5FFFE-5FFFF; [NONCHARACTER CODE POINTS]  
6FFFE-6FFFF; [NONCHARACTER CODE POINTS]  
7FFFE-7FFFF; [NONCHARACTER CODE POINTS]  
8FFFE-8FFFF; [NONCHARACTER CODE POINTS]  
9FFFE-9FFFF; [NONCHARACTER CODE POINTS]  
AFFFE-AFFFF; [NONCHARACTER CODE POINTS]  
BFFFE-BFFFF; [NONCHARACTER CODE POINTS]  
CFFFE-CFFFF; [NONCHARACTER CODE POINTS]

DFFFE-DFFFF; [NONCHARACTER CODE POINTS]  
EFFFFE-EFFFF; [NONCHARACTER CODE POINTS]  
FFFFFE-FFFFF; [NONCHARACTER CODE POINTS]  
10FFFFE-10FFFF; [NONCHARACTER CODE POINTS]  
----- End Table C.4 -----

#### [C.5](#) Surrogate codes

----- Start Table C.5 -----  
D800-DFFF; [SURROGATE CODES]  
----- End Table C.5 -----

#### [C.6](#) Inappropriate for plain text

----- Start Table C.6 -----  
FFF9; INTERLINEAR ANNOTATION ANCHOR  
FFFA; INTERLINEAR ANNOTATION SEPARATOR  
FFFB; INTERLINEAR ANNOTATION TERMINATOR  
FFFC; OBJECT REPLACEMENT CHARACTER  
----- End Table C.6 -----

#### [C.7](#) Inappropriate for canonical representation

----- Start Table C.7 -----  
2FF0-2FFB; [IDEOGRAPHIC DESCRIPTION CHARACTERS]  
----- End Table C.7 -----

#### [C.8](#) Change display properties

----- Start Table C.8 -----  
200E; LEFT-TO-RIGHT MARK  
200F; RIGHT-TO-LEFT MARK  
202A; LEFT-TO-RIGHT EMBEDDING  
202B; RIGHT-TO-LEFT EMBEDDING  
202C; POP DIRECTIONAL FORMATTING  
202D; LEFT-TO-RIGHT OVERRIDE  
202E; RIGHT-TO-LEFT OVERRIDE  
206A; INHIBIT SYMMETRIC SWAPPING  
206B; ACTIVATE SYMMETRIC SWAPPING  
206C; INHIBIT ARABIC FORM SHAPING  
206D; ACTIVATE ARABIC FORM SHAPING  
206E; NATIONAL DIGIT SHAPES  
206F; NOMINAL DIGIT SHAPES  
----- End Table C.8 -----

#### [C.9](#) Tagging characters

----- Start Table C.9 -----  
E0001; LANGUAGE TAG  
E0020-E007F; [TAGGING CHARACTERS]  
----- End Table C.9 -----